BAL

Ballantine

INSTRUCTION MANUAL

1395 Series
Terminated
Thermal
Voltage
Converters

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INSTRUCTION MANUAL

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WARRANTY

This Ballantine Laboratories, Inc. product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except for batteries, electron tubes, vacuum thermal elements, and certain other components, if any, listed in this manual. Ballantine Laboratories, Inc. will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Ballantine Laboratories, Inc. prepaid, and provided the proper preventive maintenance and calibration procedures as listed in this manual have been followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BALLANTINE LABORATORIES, INC. IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

CERTIFICATION

Ballantine Laboratories, Inc. certifies that this equipment meets all applicable Ballantine specifications at time of shipment from the factory as determined by thorough testing and inspection. Ballantine further certifies that its measurements are traceable to the United States National Institute of Standards and Technology. All instruments used in calibrating Ballantine products are standardized by systematic reference to NIST-traceable standards as described in the validation procedures shown below.

REFERENCE STANDARDS

DC	10 mV - 750 V	0.002 - 0.003%
20 Hz - 50 kHz	0.5 V - 500 V	0.004%
20 Hz - 10 MHz	0.5 V - 100 V	0.05%
DC - 30 MHz	0.5 V - 100 V	0.35%
DC - 700 MHz	10 μV - 0.5 V	1% - NIST
10 MHz - 1000 MHz	1 V - 300 V	1% - NIST

WORKING STANDARDS

THERMAL VOLTAGE CONVERTERS, BALLANTINE 1397A
TRANSFER STANDARD, BALLANTINE 1605A
MICROPOTENTIOMETERS, BALLANTINE 440
RATIO TRANSFORMERS, GERTSCH

CAUTION
WARRANTY INFORMATION

The Ballantine Warranty for thermal devices specifically excludes the thermal element and damage to the type 874 connectors.

Please mate type 874 connectors with care to avoid breakage of connector prongs.

Please read the instruction manual and avoid applying any common mode voltage greater than 20 V or any excessive input voltage overload which may damage or destroy the thermal element.

Ballantine's Quality Assurance program satisfies the requirements of MIL-I-45208.

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PART 1. GENERAL INFORMATION

1-1. PURPOSE

The Ballantine Thermal Converters (Figure 1-1) convert complex ac input signals to dc voltages, accurately proportional to the rms value of the input. All models essentially have a flat response from 10 Hz to 10 MHz.

Typical applications of the thermal converters include:

a. Calibration of AC and RF voltmeters.

b. Frequency response measurements of signal generators, amplifiers, and detectors.

c. Power measurements of complex waveforms in 50 ohm systems. Converter output voltage is proportional to true input power.

1-2. SPECIFICATIONS

Voltage Ranges:

MODEL	Z	VOLTAGE RANGE
1395A-0.4	50 Ω	0.08 - 0.54 (to 10 MHz)
1395A-1	50 Ω	0.2 - 1.3 (to 10 MHz)
1395A-3	50 Ω	0.6 - 3.9 (to 10 MHz)
1395A-6	50 Ω	1.2 - 8.1 (to 10 MHz)
1395A-1 MOD 75	75 Ω	0.2 - 1.3 (to 10 MHz)
1395A-1 MOD 93	93 Ω	0.2 - 1.3 (to 10 MHz)
1395A-1 MOD 135	135 Ω	0.2 - 1.3 (to 10 MHz)
1395A-1 MOD 150	150 Ω	0.2 - 1.3 (to 10 MHz)
1395A-3 MOD 600	600 Ω	0.6 - 3.9 (to 10 MHz)

1395H Series: Same as above, but supplied with ±0.005% reversal error thermoelement. Never exceed 5 mA heater current to maintain dc reversal error specification.

RMS voltage is continuous maximum equivalent to dc heating value. Peak voltage limited to 150% of full scale rms at 30% maximum duty factor and represents absolute maximum value for recurrent or non recurrent input signals with on time <1 ms.

Input Resistance:
50 Ω ±0.15 Ω; 75 Ω ±0.25 Ω; 93 Ω ±1 Ω; 135 Ω, 150 Ω, 600 Ω ±1% measured at dc and nominally constant to 10 MHz.

Calibrated Frequency Range:
DC and 10 Hz to 10 MHz (100 MHz with Option 09).

Usable Frequency Range:
DC and 5 Hz to greater than 100 MHz.

THERMOCOUPLE CHARACTERISTICS (at 23°C ±1°C):

Nominal Heater Current: 5 mA at full scale

Maximum safe input voltage:
150% of full scale input voltage rating. Maximum peak voltage is 1.8 times full scale with 30% duty cycle and maximum on time <1ms.

DC Output Voltage:
7 mV ±15% at full scale input voltage

DC Output Resistance: 7 to 9.5 ohms

Maximum AC/DC Reversal Error at full scale:
±0.04% "A" Series and ±0.005% "H" Series

Temperature Coefficient:
Nominally 2000 ppm/°C

Couple output voltage to heater (ground):
Normally should not exceed ±10 V, absolute maximum ±50 V peak

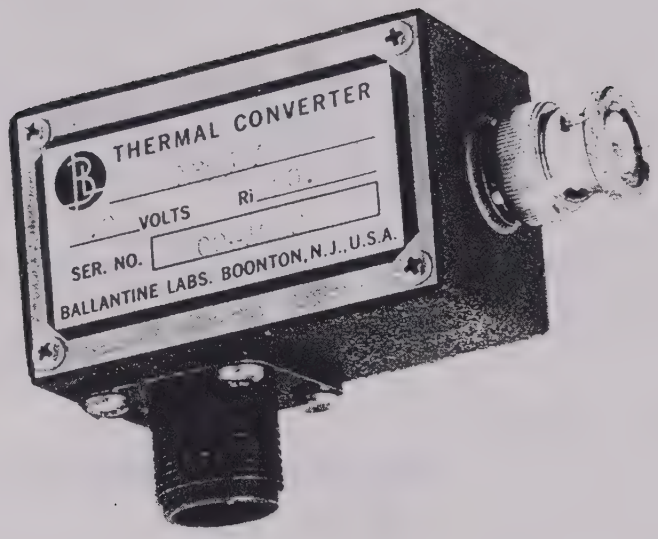
ENVIRONMENT

Operating Temperature: 4°C to 40°C

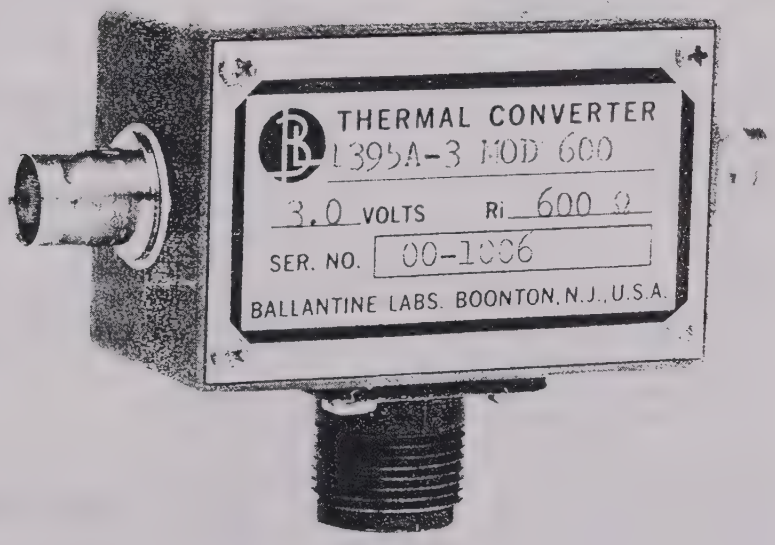
Humidity: 0 to 90% RH (no condensation)

Operating Altitude: to 10,000 ft.

Storage Altitude: to 50,000 feet



1395A SERIES
(UNBALANCED)



1395A SERIES
(BALANCED)

Figure 1-1. 1395A Series Thermal Voltage Converter

MECHANICAL (1395A SERIES)

Height: 1 1/4 in (32 mm)

Width: 1 3/8 in (36 mm)

Length (exclusive of connectors): 3 in (78 mm)

Weight: 5 1/2 oz (156 gm)

Input Connectors: Male BNC

Output Connectors:
3 pin Male Receptacle Type MS3102A-10SL-3P

Optional Mating Connector:
3 pin Female Type MS3106A-10SL-3S. Ballantine Part No. 31-10002-0A

AVAILABLE OPTIONS

For 50 Ohm Units Option 09:
Calibration report and correction data points at 30 MHz, 70 MHz and 100 MHz.

For Balanced Units Option 08:
Calibration report and correction data points at 30 MHz and 50 MHz.

1395H Series:
The 1395H is similar to the 1395A Series in all respects except that vacuum thermoelement has ±0.005% dc reversal error at full scale.

TABLE 1-1. CALIBRATION UNCERTAINTY

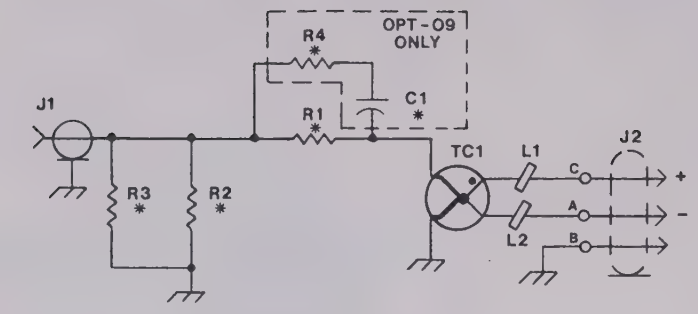
Frequency Response checked with a standard converter traceable to NIST. Voltages measured at a point equivalent to the center of a BNC Tee Type UG 274B/U connected to the converter.

FREQUENCY RANGE	COMPARISON TO STANDARD	BALLANTINE REFERENCE STANDARD UNCERTAINTY	TOTAL LIMIT IN %
DC, 10 Hz to 20 Hz	within ±0.05%	±0.05%	±0.10%
DC, 20 Hz to 20 kHz	within ±0.01%	±0.01%	±0.02%
DC, 20 kHz to 50 kHz	within ±0.01%	±0.02%	±0.03%
DC, 50 kHz to 1 MHz	within ±0.01%	±0.06%	±0.07%
DC, 1 MHz to 10 MHz	within ±0.05%	±0.12%	±0.17%

PART 2. CIRCUIT DESCRIPTION

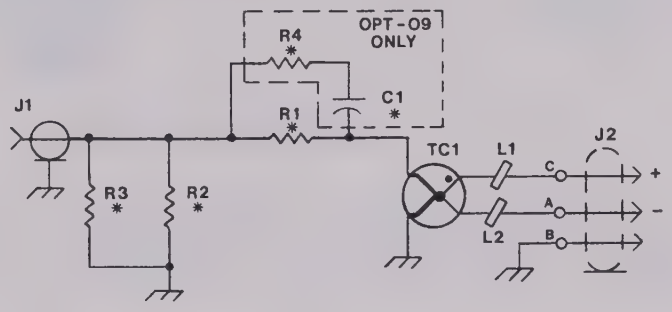
2-1. GENERAL

A 90 Ω UHF thermoelement which contains a heater and a thermoelectric junction, comprise the basic circuit of the thermal converter (figure 2-1 through 2-7). The ac input current elevates heater temperature and the thermoelectric junction generates a dc voltage proportional to the heater temperature. Therefore, the output voltage of the thermal converter is proportional to the input heating power. Resistor R4 limits the current through the thermoelement to 5 mA with maximum rated voltage. R1, R2, and R3 adjust the input resistance.



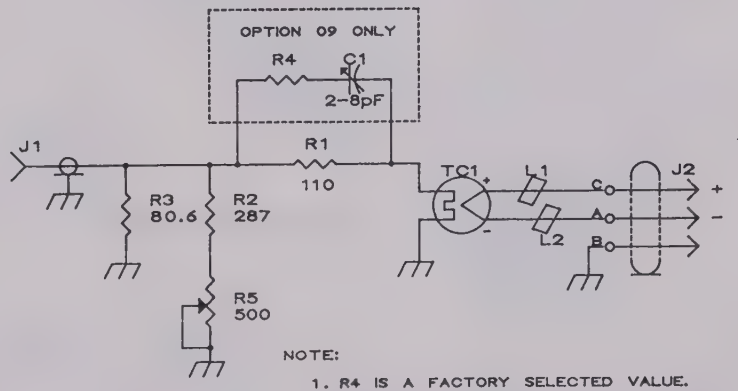
NOTES:
1. R1 & R2 SEE TABLE 2-1
2. R3 IS A FACTORY SELECTED VALUE
3. R4 IS A CAL ITEM AND C1 AND R4 ARE USED ONLY IN OPTION 09.
(R4 IS ONLY APPLICABLE TO MODEL 1395A(H)-0.4 OPT.-09)

Figure 2-1. Model 1395A-0.4, Schematic Diagram



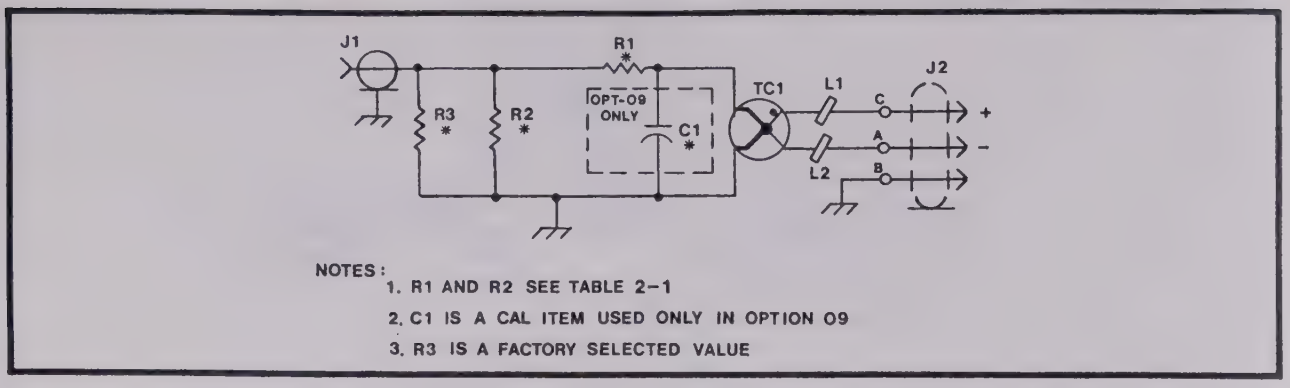
NOTES:
1. R1 & R2 SEE TABLE 2-1
2. R3 IS A FACTORY SELECTED VALUE
3. R4 IS A CAL ITEM AND C1 AND R4 ARE USED ONLY IN OPTION 09.
(R4 IS ONLY APPLICABLE TO MODEL 1395A(H)-0.4 OPT.-09)

Figure 2-2a. Model 1395A-1 S/N Below 4000, Schematic Diagram



NOTE:
1. R4 IS A FACTORY SELECTED VALUE.

Figure 2-2b. Model 1395A-1 S/N Above 4000, Schematic Diagram



NOTES:
1. R1 AND R2 SEE TABLE 2-1
2. C1 IS A CAL ITEM USED ONLY IN OPTION 09
3. R3 IS A FACTORY SELECTED VALUE

Figure 2-3a. Model 1395A-3 S/N Below 4000, Schematic Diagram

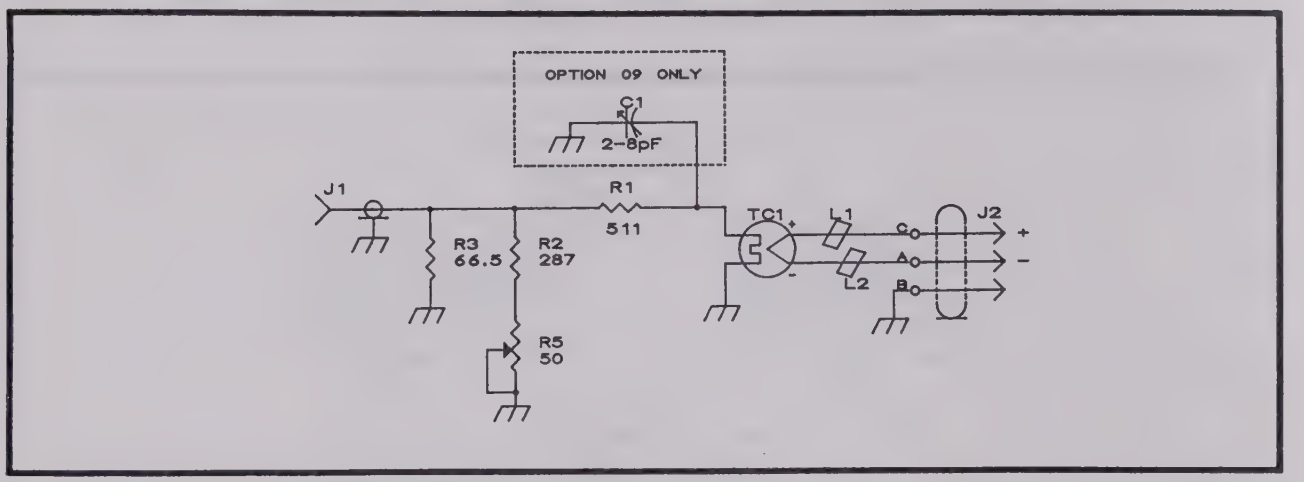
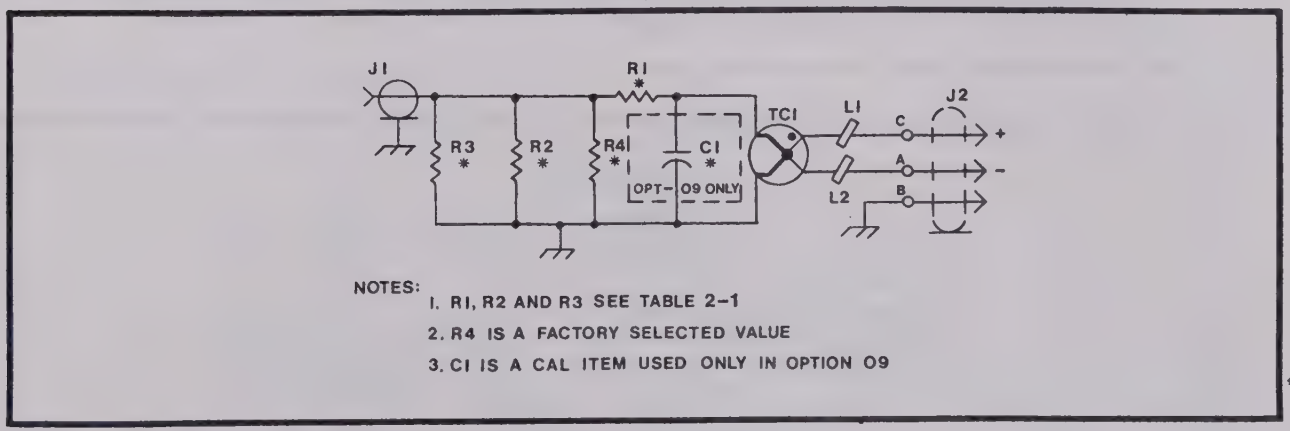


Figure 2-3b. Model 1395A-3 S/N Above 4000, Schematic Diagram



NOTES:
1. R1, R2 AND R3 SEE TABLE 2-1
2. R4 IS A FACTORY SELECTED VALUE
3. C1 IS A CAL ITEM USED ONLY IN OPTION 09

Figure 2-4a. Model 1395A-6 S/N Below 4000, Schematic Diagram

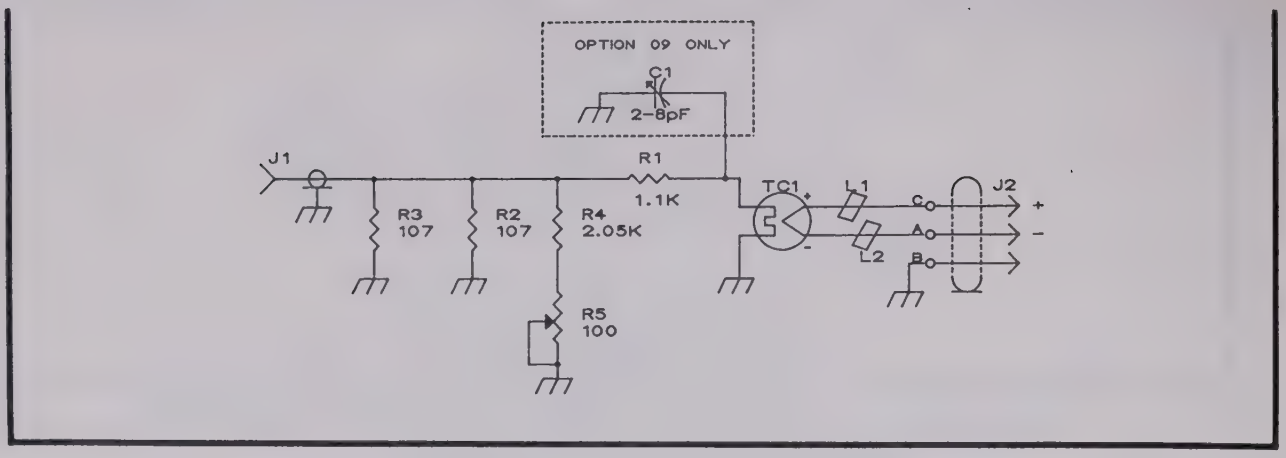


Figure 2-4b. Model 1395A-6 S/N Above 4000, Schematic Diagram

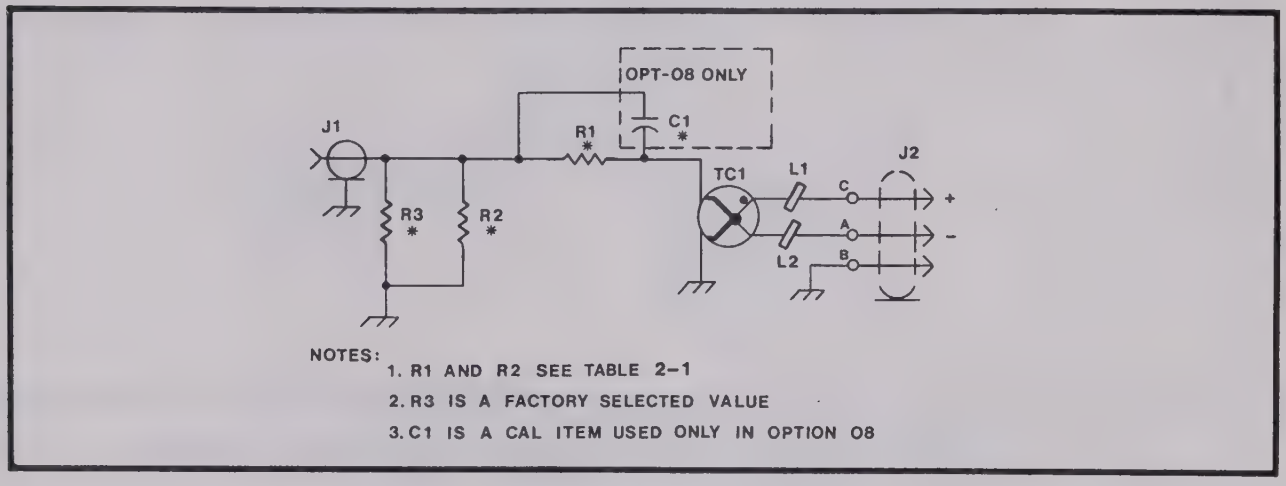


Figure 2-5a. Model 1395A-1MOD75 and 1395A-1MOD93 S/N Below 4000, Schematic Diagram

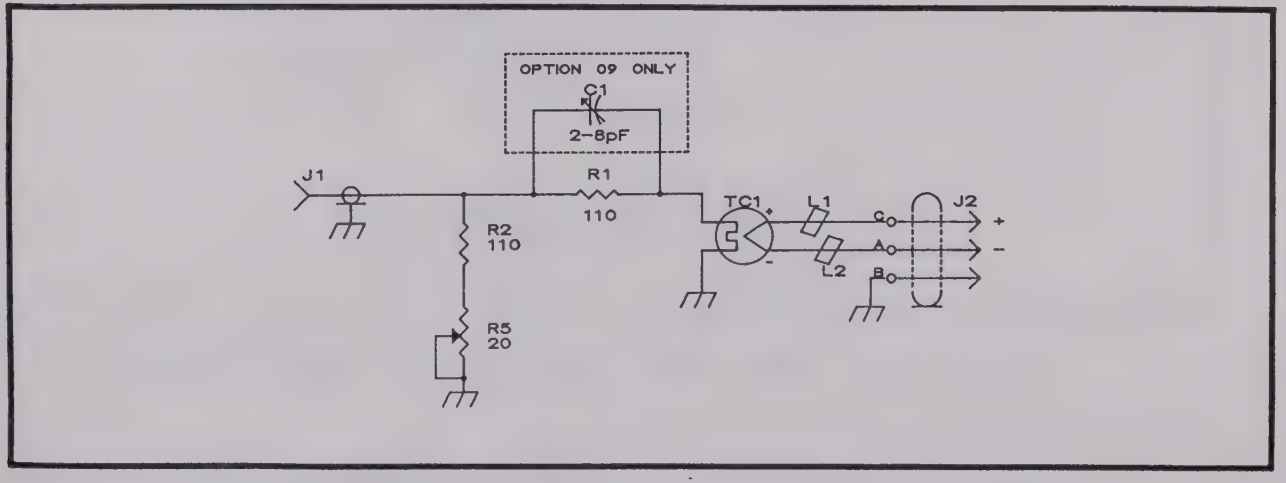


Figure 2-5b. Model 1395A-1MOD75 S/N Above 4000, Schematic Diagram

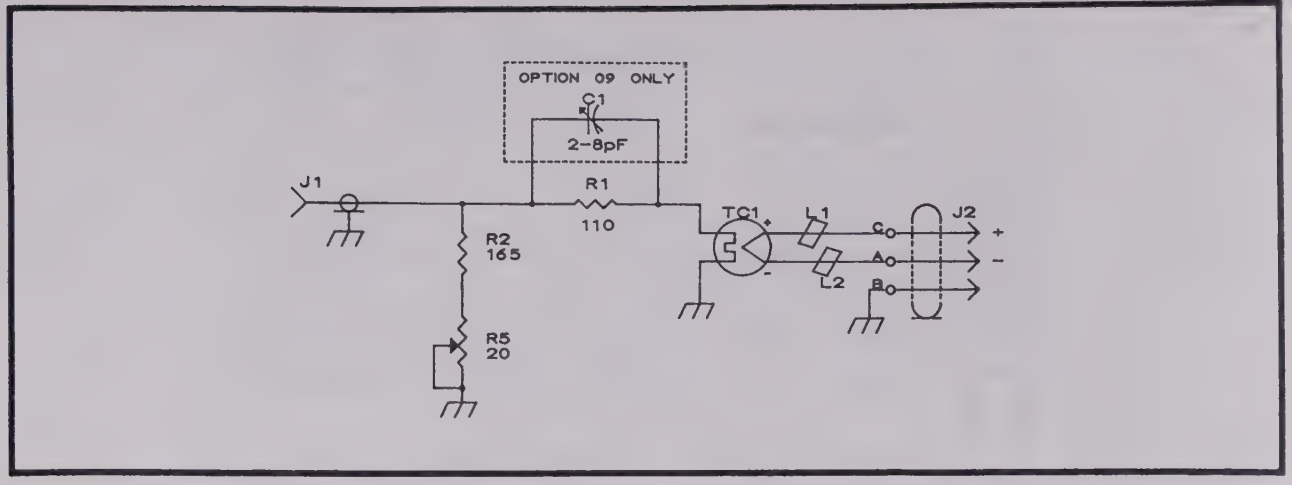


Figure 2-5c. Model 1395A-1MOD93 S/N Above 4000, Schematic Diagram

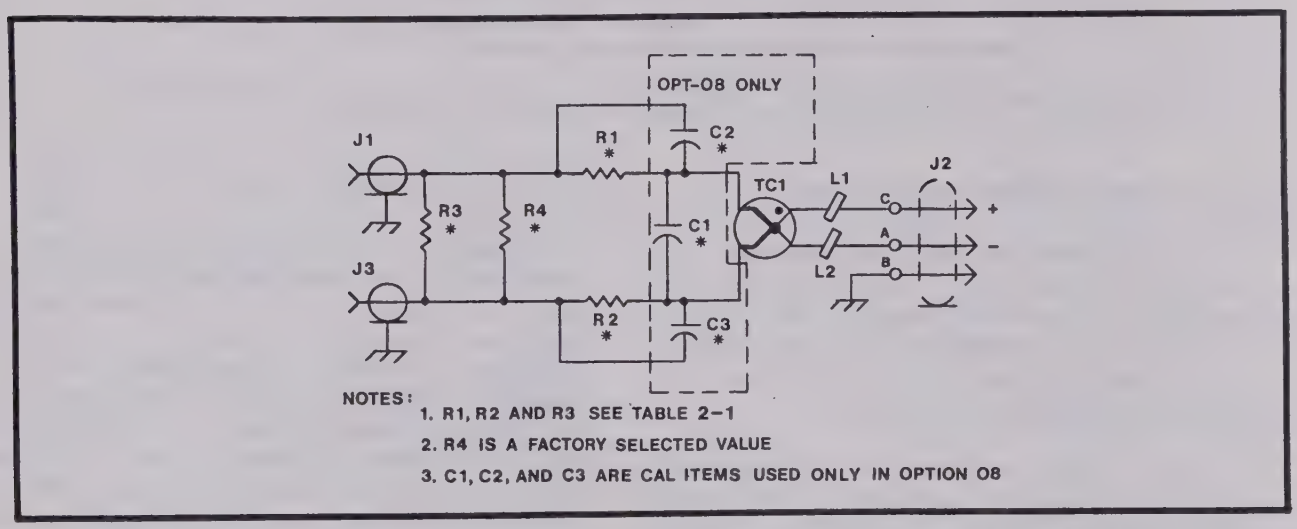


Figure 2-6. Model 1395A-1M135 and 1395A-1M150, Schematic Diagram

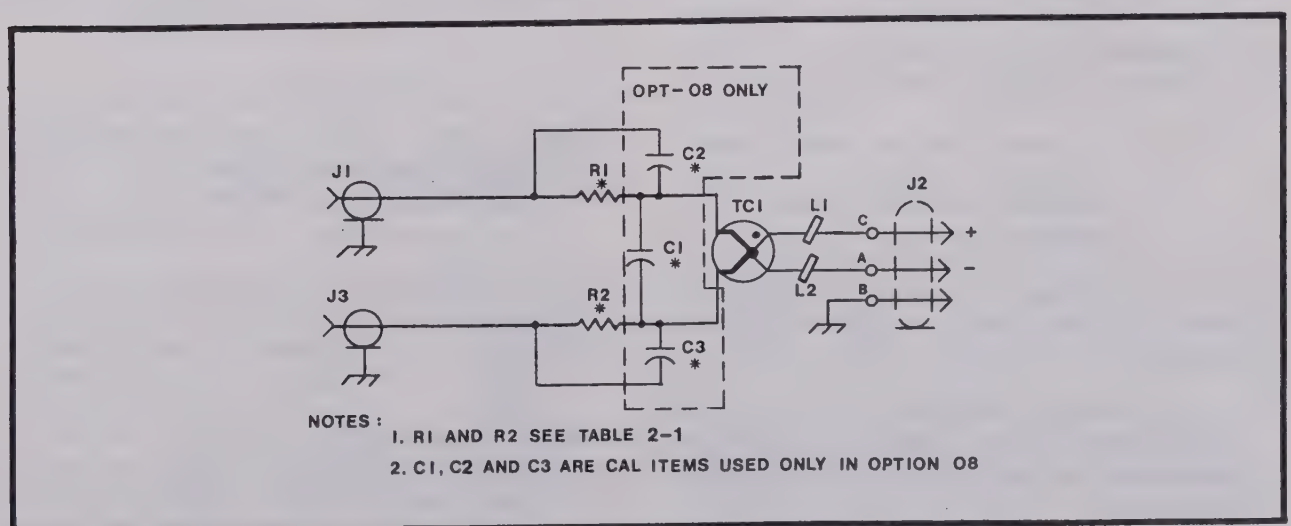


Figure 2-7. Model 1395A-3M600, Schematic Diagram

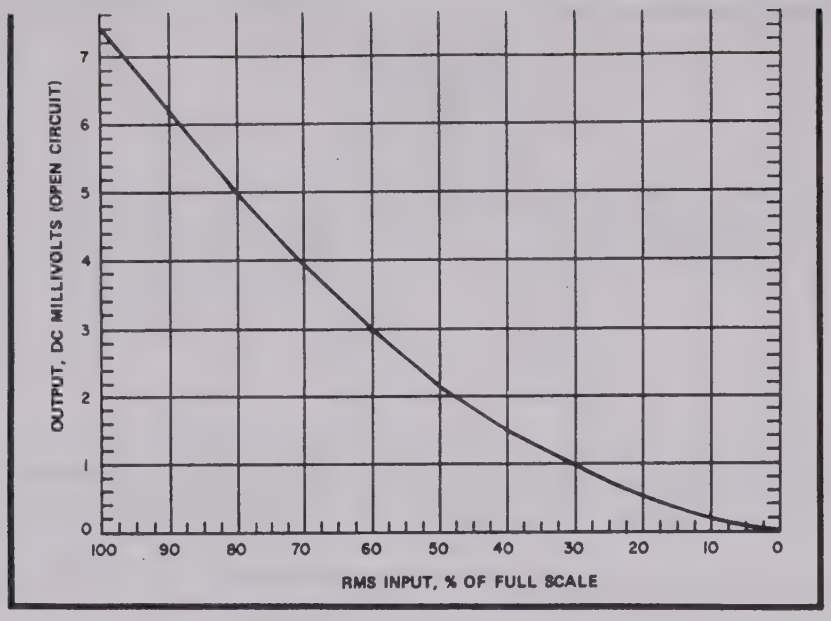


Figure 2-8. Input-Output Relationship

2-2. INPUT-OUTPUT RELATIONSHIP

The output voltage of the thermal converter is a function of input power. Therefore, the output varies as the square of the input. When the input is doubled, the output will be four times as great. When the input is halved, the output will drop to one fourth.

For input changes of less than 3%, the input-output relationship is essentially linear; and the percent output change is equal to twice the percent input change. The following formula shows the relationship.

$$\% \text{ input change} = \frac{E_{dc}}{NE_{dc}} \times 100$$

where E_{dc} = thermal converter output voltage

N = Square law conformity of the TE. Nominally 1.8

If the input lever is to be varied by more than 3% the actual input-output characteristic should be measured. This is best done at dc.

Since the thermal elements in the converter have a small thermal lag, a ten second settling time is recommended for measurements requiring the utmost precision.

Figure 2-8 graphically illustrates the input-output relationship.

2-3. INPUT DYNAMIC RANGE

The dynamic range of Ballantine thermal converters is limited by the resolution and noise (at best about 100 nanovolts) of the system used to measure the output voltage of the couple. At full scale input level the output is approximately 7 mV. The conversion follows a square law relationship and the dc output therefore drops by 100 whenever the input is reduced by a factor of 10. The 1398A Series has a dynamic input voltage range somewhat greater than three to one which permits better than 0.005% resolution when the dc output measuring system has 100 nV or better resolution with noise effects below 20 nanovolts.

TABLE 2-1a. Model 1395A Series Resistor Values For Units With Serial Number Below 4000

Model	R1	R2	R3
1395A-0.4	10 Ω	107 Ω	N/A
1395A-1	110 Ω	66.5 Ω	N/A
1395A-3	511 Ω	54.9 Ω	N/A
1395A-6	1.1 kΩ	107 Ω	107 Ω
1395A-1 MOD 75	110 Ω	121 Ω	N/A
1395A-1 MOD 93	110 Ω	178 Ω	N/A
1395A-1 MOD 135	80.6 Ω	80.6 Ω	294 Ω
1395A-1 MOD 150	80.6 Ω	80.6 Ω	383 Ω
1395A-3 MOD 600	255 Ω	255 Ω	N/A

TABLE 2-1b. Model 1395A Series Resistor Values (in Ohms) For Units With Serial Number Above 4000

Model	R1	R2	R3	R4	R5
1395A-1	110 Ω	287 Ω	80.6 Ω	N/A	500 Ω
1395A-3	511 Ω	287 Ω	66.5 Ω	N/A	50 Ω
1395A-6	1.1 kΩ	107 Ω	107 Ω	2.05 kΩ	100 Ω
1395A-1 MOD 75	110 Ω	110 Ω	N/A	N/A	20 Ω
1395A-1 MOD 93	110 Ω	165 Ω	N/A	N/A	20 Ω

PART 3. OPERATION

3-1. PRECAUTIONS

Burnout of the thermoelement heater occurs so rapidly when the maximum peak power is exceeded that the rise in dc couple output voltage cannot be readily detected. Therefore it is necessary to take the following precautions to avoid damaging the thermocouple.

a. Be sure the voltage being measured is reduced to its lowest value before connecting or disconnecting the thermal converter input. Never allow intermittent wiring connections or poorly assembled connectors.

b. Provide a method for limiting, monitoring or controlling the input voltage being measured by the thermal converter.

c. Do not change the frequency of the generator providing the voltage to be measured without first reducing the voltage of the generator to its lowest value. Caution: Most signal generators and oscillators produce large transient voltages when changing range.

d. Monitor heater input by observing TE dc output voltage. Do not allow the open-circuit dc couple voltage to exceed 7 millivolts (equivalent to 5 mA of heater current).

e. Non-sinusoidal waveforms, such as transients and pulse trains must have peak voltages which crest within the peak voltage and duty factor specifications.

f. Use precision attenuators with matching impedance to the 1395A in use. Place them ahead of the thermal converter when larger voltages or unknown signals are to be measured.

g. When input voltages larger than 6 V rms are to be measured or when higher impedance thermal converter inputs are required use:

1. The Ballantine 1605 (ATS) Auto-Balance Transfer Standard

2. The Ballantine Coaxial Thermal Converter Series 1394 or 1397 200 ohms/volt dc to 100 MHz.

h. Never exceed the breakdown voltage rating of ±50 volts peak between couple and heater during set up of instrumentation and while making measurements. Ground all instrumentation. Provide a zener limiter or resistor from the thermocouple to a ground return path to avoid exceeding the breakdown rating.

3-2. DC OUTPUT MEASUREMENTS

The measurement reliability of thermal converter measurements is based on the resolution and signal to noise ratio of the dc output measuring instrument. Figure 3-1 shows a stable output monitoring circuit. The Ballantine 1610A Control Unit is used in the Lindeck potentiometer mode which uses a variable dc source to buck out the dc potential generated in the 1395. The null meter in the 1610 is used to indicate when the variable dc voltage equals the 1395 output. Resolution to ±1 μV is attainable. The 1610 operates on internal rechargeable batteries which improves reading accuracy by avoiding ac mains and ground current

errors. The setting of the variable dc source is of arbitrary amplitude but its stability provides "memory" to establish oscillator output variations with changes in oscillator frequency.

A stable 6.5 digit nanovoltmeter such as the Keithley 181 may also be used. Unlike the 1610 it is not battery operated and has no variable dc source as a memory. The digital nanovoltmeter memory lies in its calibration stability. It will read the changes in dc output amplitude from the 1395 instead of the Lindeck potentiometer nulling system described above. The Keithley 181 includes a ZERO set mode which can approximate a deviation from null measurement.

While making all thermal converter measurements, a constant ambient temperature should be maintained. The range of 23°C ±3°C is recommended. The thermal converter responds to changes in ambient temperature (with a temperature coefficient of approximately 2000 ppm/°C) as well as responding to the heating power of the input signal.

3-3. FREQUENCY RESPONSE MEASUREMENTS

A test set up for making accurate frequency response measurements is shown in figure 3-1. The following steps describe the measurements.

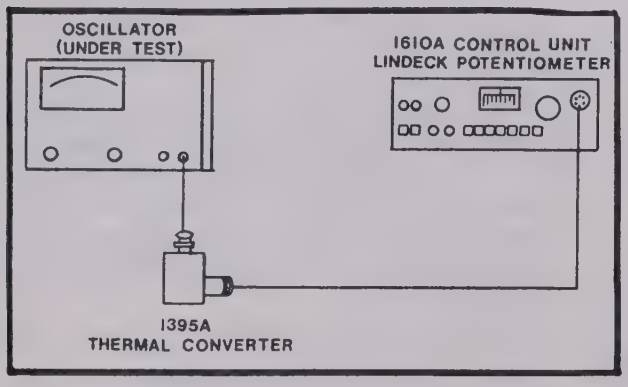


Figure 3-1. Frequency Response Measurements Test Set-Up

a. Set the oscillator and reference supply output levels to minimum.

b. Connect the test equipment as shown in figure 3-1 keeping the connecting cable between the oscillator and thermal converter as short as possible. Use shielded low noise cables and ground the reference voltage supply to the chassis ground of the null meter.

c. Adjust oscillator amplitude for an indication of about 7 mV on the null meter.

CAUTION

Do not exceed the rated input of the thermal converter. Always reduce the input before changing frequency range of circuit under test. Any overload or high voltage transient may destroy the thermoelement. Ground test equipment and do not exceed couple to heater voltage rating.

d. Adjust the reference supply for a null indication within 1 μV. Once a null is obtained, do not readjust the oscillator or reference supply outputs.

e. Change the input frequency and observe thermal converter output changes. Remember that the percent of converter output change read on the null meter equals twice the percentage input signal level change.

3-4. GENERATING AN ACCURATE CALIBRATION SIGNAL

The test setup shown in figure 3-2 provides a test signal that may be used for both frequency response and absolute value calibration at any frequency within the thermal converter range. The dc standard provides the absolute value voltage reference, and the test oscillator generates the ac calibration signal. When S1 is set to the dc position and output of the DC Voltage Standard is set to the desired calibration voltage, the reference supply is adjusted for a null indication on the null meter. When S1 is switched to the ac position, the oscillator output amplitude is adjusted to re-establish a null indication. This sets the rms value of the oscillator output equal to the dc voltage standard output. The oscillator output signal is used for the instrument under test.

3-5. DC REVERSAL ERROR

DC inputs of opposite polarity will produce slightly different outputs from the thermal converter. This difference in thermocouple outputs for positive or negative input signals is called the dc reversal error. Sinusoidal input signals have equal energy content in positive and negative half cycles. These sinewave signals automatically average dc reversal errors in the

thermocouple. Nevertheless, unidirectional signals such as pulse trains, switching transients, and sinewaves with dc offset will primarily have energy content in one polarity and, therefore, thermal converters require dc reversal error correction. The dc reversal error is less than 0.05% and does not affect most measurements, but it should be considered to achieve maximum accuracy. For best dc reversal error performance specify 1395H Series.

Instruction for correcting precise measurements for dc reversal error are given in the following calibration procedure in Part 4.

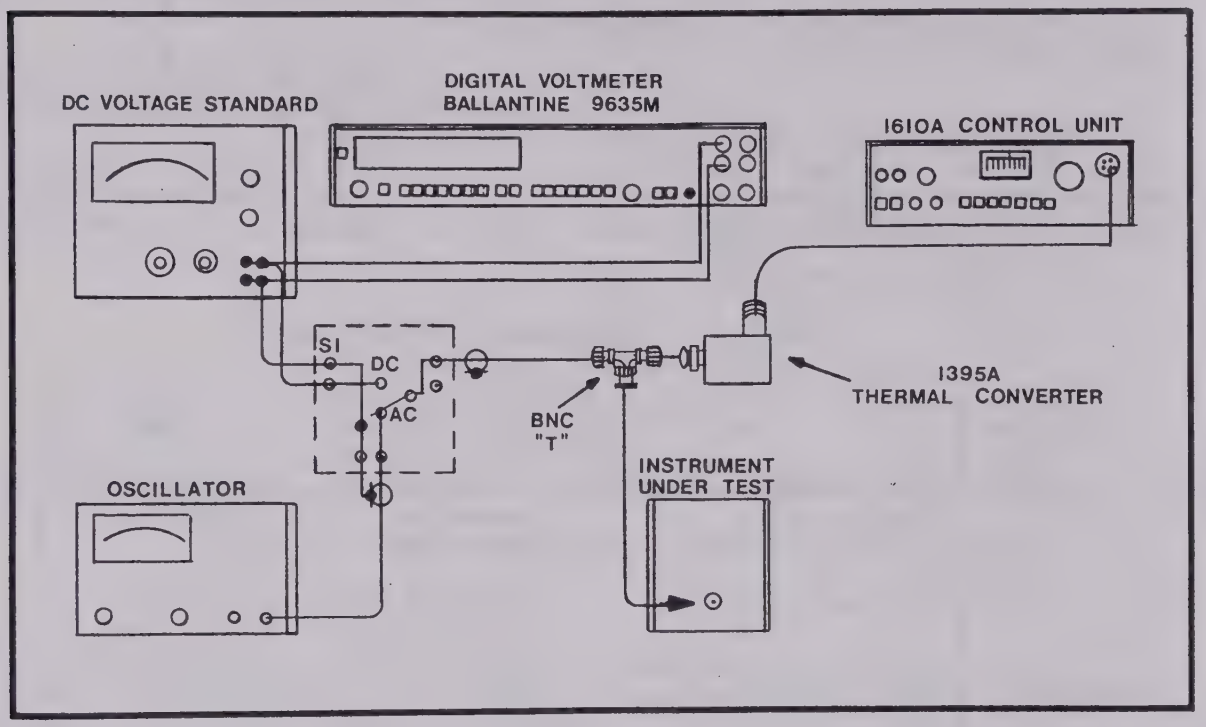


Figure 3-2. Generation of a Precise Test Signal Test Set-Up

PART 4. CALIBRATION

4-1. CALIBRATION VERIFICATION PROCEDURE

The steps that follow describe a "covers on" user procedure for generating a 1 volt calibration signal within the thermal converter specifications. 1 volt is applicable to 1395A-1 units. For 1395A-0.4, 1395A-3, and 1395A-6 use 0.4 volts, 3 volts, and 6 volts respectively. Steps c through h describe the procedure for compensating dc reversal error.

NOTE

A thermal converter is a true rms converter responsive to the true heating value of the input signal. Average responding circuits react differently to harmonic and waveshape distortion. Calibration is normally performed with pure sinusoidal waveforms and any noise, waveshape error or harmonic distortion present will create a calibration error between the thermal converter and the instrument under test. Note that the thermal converter always measures the entire energy content (heating value) of the input calibration signal including harmonics, noise energy, and non-harmonically related distortion. Use of a low distortion test oscillator is required to avoid possible calibration error of the instrument to be checked.

CAUTION

Never exceed the couple to heater breakdown voltage rating.

a. Set the test oscillator and dc voltage standard output level to minimum.

b. Connect the test equipment and instrument under test as shown in figure 3-2. Keep all connecting cables as short as possible. Perform these tests in a low electrical noise or shielded environment. Always ground test equipment.

c. Set S1 (in figure 3-2) to dc, and the dc voltage standard output to +1.000 V ±0.01%.

d. Adjust the reference supply for a null indication on the null meter within ±10 µV. Record the null meter indication. Once null is obtained, do not readjust reference supply output.

e. Reverse the polarity of the dc voltage standard output and again record the null meter reading.

f. Add the null meter reading of steps d and e.

g. Divide the sum of step f by 2. This averages the dc reversal error of the thermal converter.

h. Readjust the reference supply until the null meter indicates the average reading determined in step g.

i. Set S1 to ac and the oscillator frequency to 1 kHz. Set the oscillator output so that the

TABLE 4-1. RECOMMENDED TEST EQUIPMENT

Qty.	ITEM	RECOMMENDED	ALTERNATE
2	DC Null Meter/DC Micro Voltmeter 15 µV to 100 V	Ballantine 1610A Control Unit Lindeck Potentiometer	Keithley 181 Nanovoltmeter
1	AC Voltage Standard	Ballantine 6400A	Datron 4200
1	Precision Digital Voltmeter 100 µV resolution on 1 volt scale. Accuracy ±0.01%.	Ballantine 9635M	Keithley 181
1	Oscillator 10 Hz to 10 MHz 3 volts into 50 ohms	HP 651B	HP 652
1	Power Supply DC, 0 to 10 V, 0 to 1 amp	Power Designs 1515B	HP 6213A
1	Impedance Bridge	General Radio Type 1608A	----------
1	50 ohm Feed Thru Termination	Ballantine 12630A	HP 11048B
1	AC Voltmeter. 1 mV full scale, 10 Hz to 10 MHz	Ballantine 3045A	Ballantine 3056A
1	BNC Tee Connector UG 274/C	Ballantine 12619A	----------
1	NIST traceable Thermal Converter	Ballantine 1395A-0.4	----------
1	NIST traceable Thermal Converter	Ballantine 1395A-1	----------
1	NIST traceable Thermal Converter	Ballantine 1395A-3	----------
1	NIST traceable Thermal Converter	Ballantine 1395A-6	----------

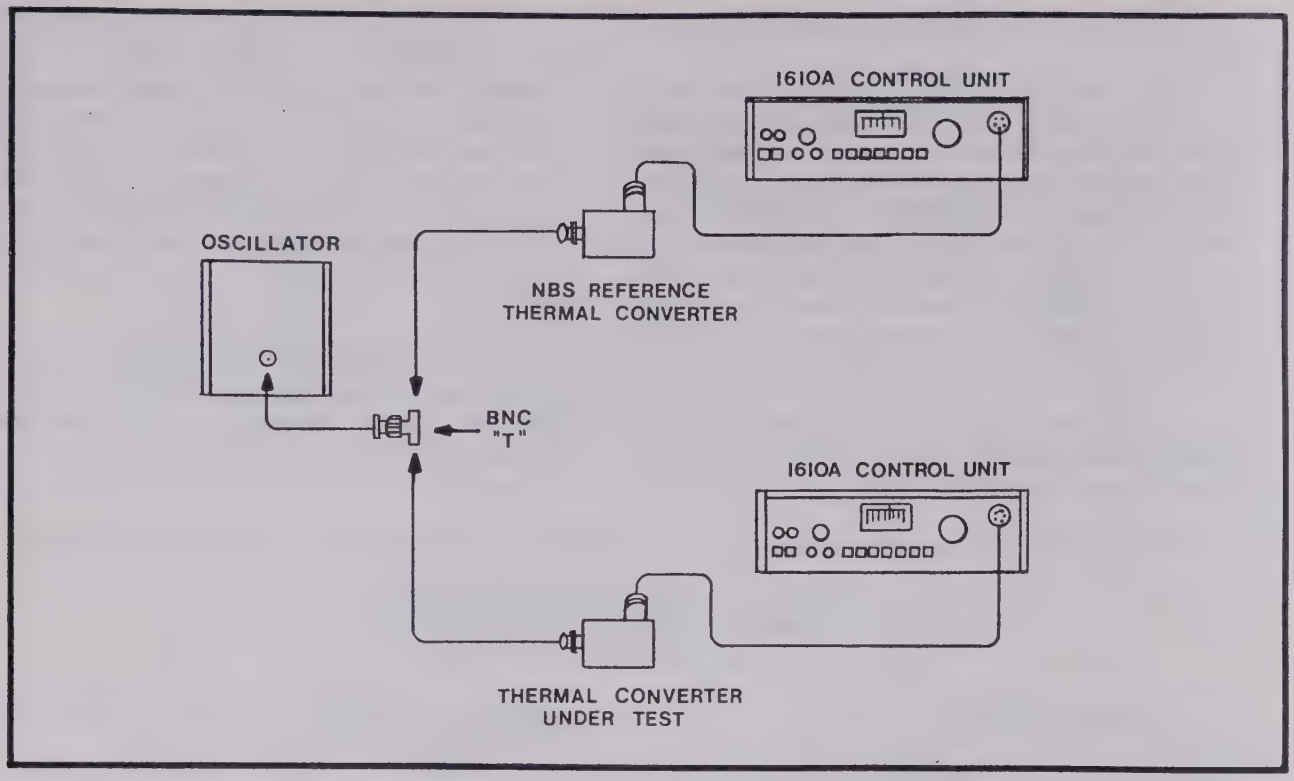


Figure 4-1. Thermal Converter Calibration Test Set-Up

null meter indication equals the indication recorded in step h. This sets the oscillator output to 1 V rms.

j. Record the reading and error of the instrument under test. This instrument will usually be a passive device such as an ac voltmeter, wave analyzer, spectrum analyzer, etc.

CAUTION

Do not change the oscillator frequency range without first lowering oscillator output. Switching transients may destroy the thermoelement.

k. Adjust the frequency to the desired test frequency. Then readjust the oscillator output amplitude for the same null meter indication obtained in step h. Record the reading and error of the instrument under test. If desired, apply the ac-dc correction of your 1395A at each frequency where a 1 volt (or 0.4, 3, or 6 volt) signal is generated.

l. Repeat steps j and k for each test frequency desired.

4-2. AC-DC DIFFERENCE CALIBRATION

The test setup for calibrating ac-dc difference of a thermal converter to an NIST calibrated reference thermal converter is shown in figure 4-1. With this setup, the thermal converter can be calibrated to within ±0.05% of the reference. The steps that follow describe the calibration procedure.

a. Set the test oscillator and both reference supply outputs to minimum.

b. Connect the test equipment as shown in figure 4-1. Keep connecting cables to thermal converters as short as possible. Operate in a low noise or shielded environment. Consider the use of battery operated instrumentation to avoid ground loop error and power line disturbances.

c. Adjust the amplitude of the oscillator for an indication of approximately 7 mV on both null meters. Set the oscillator frequency for 1 kHz.

d. Adjust the reference supplies for a null indication on the respective null meters.

e. Change the oscillator frequency to 10 Hz.

f. Readjust the oscillator amplitude for a null indication on the null meter connected to the NIST reference thermal converter. The null meter connected to the thermal converter under test should indicate the same as the reference null meter. If not, record the error and remember that the percent change in the thermal converter output is equal to twice the percent change in the input (i.e. 1% change in dc output equals 1/2% input signal change).

g. Repeat steps e and f at 50 Hz, 500 Hz, 5 kHz, 50 kHz, 500 kHz, 1 MHz, 6 MHz, and 10 MHz. In each case, record the error.

h. Use the error data collected in steps e to g, make ac-dc corrections whenever using the thermal converter. If the difference between the reference thermal converter and the thermal converter under test is greater than the specifications in the "With reference to standard" column in Table 1-1, the thermal converter is not operating properly. Refer to repair instructions in paragraph 5-1.

i. The calibration of the thermal converter should be checked against an NIST traceable reference thermal converter at least once every six months during the first year, and once a year thereafter.

PART 5. REPAIR AND MAINTENANCE

5-0. INTRODUCTION

The 1395 series of terminated thermal converters are precision wideband instruments. The 50 ohm input resistance units are manufactured with selected components and, more recently, with adjustable trim potentiometers and trim capacitors. The following procedure describes component selection and component adjustment for calibrating and maintaining the 1395 series of terminated thermal converters.

5-1. REPAIRING THE THERMAL CONVERTER

If the thermal converter is out of ac-dc difference calibration below 10 MHz or it has no dc output, then the UHF thermoelement should be replaced. Since the values of input resistor R3 and series resistors R4 and R5 in the circuit (see figures 2-1 through 2-7) depend on variations in thermoelement characteristics, they must always be reselected when the thermoelement is replaced.

5-2. OPTIONAL SELECTION OF SERIES CURRENT LIMITING RESISTORS, R4 and R5

Current through the thermoelement is adjusted to 5 mA with a full scale input by R4 and R5. In the Model 1395A-3, R4 and R5 have a total value of about 510 Ω. In the Model 1395A-1, R4 and R5 have a total value of about 110 Ω, and in the Model 1395A-0.4, R4 and R5 are deleted. R4 and R5 should always be 1/2 watt (40°C) ±1% precision film resistors.

The test set up for selecting R4 and R5 is shown in figure 5-1. The power supply provides a known input, and the dc voltmeter monitors the thermoelement output. R4 and R5 are selected to adjust the thermoelement output to 6.5 mV with 90% full scale input. The selection of the series resistor is optional since a ±1% resistor tolerance generally meets the required specification. To select R4 and R5 proceed as follows:

a. Turn the power supply off and connect it to the thermoelement, dc voltmeter, and an initial value of series resistor.

-For Model 1395A-1 the series resistance is approximately 110 Ω. This may be one single resistor or two each 54.9 Ω resistors in series as R4 and R5.

-For Model 1395A-3 the series resistance is approximately 505 Ω to 570 Ω. A single 510 Ω ±1% resistor may be used or a 261 Ω and a 244 Ω resistor connected in series may be used as R4 and R5.

-For Model 1395A-6 the series resistance is approximately 1100 Ω and a single resistor is usually employed.

b. Using the voltmeter as a monitor, slowly adjust the power supply output to 0.9 volts for Model 1395A-1 or 2.85 volts for Model 1395A-3 and 5.4 volts for Model 1395A-6.

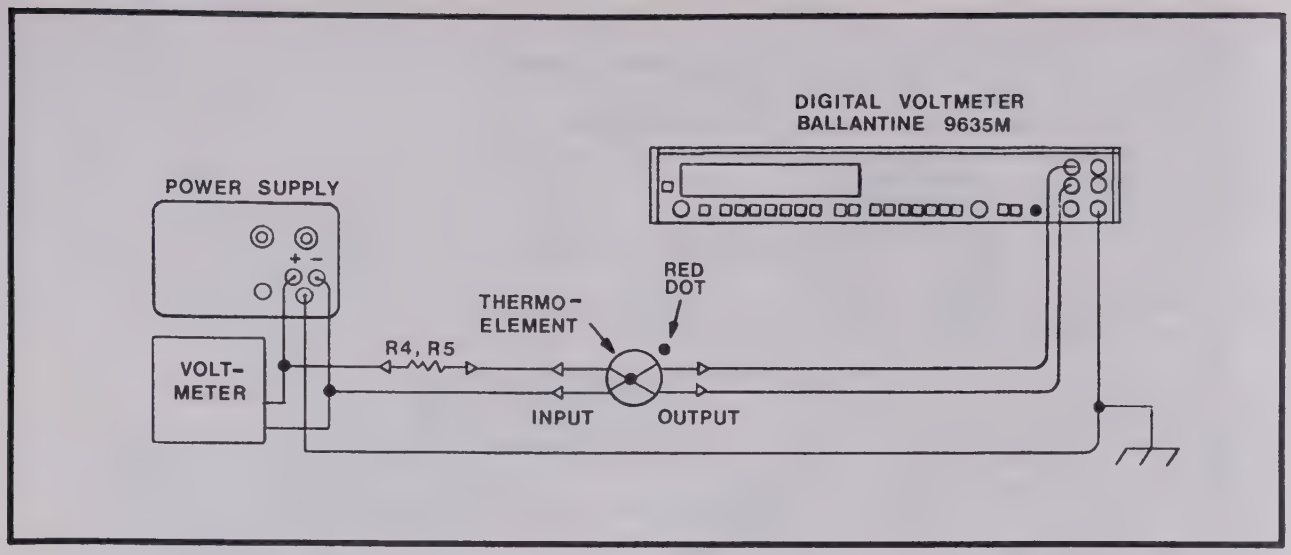


Figure 5-1. Resistor Selection
(Selection of R4 or R5 or a single equivalent resistor in series with the heater of the thermal converter.)

c. Connect the voltmeter to thermoelement output and observe a 6.5 mV reading. If the output is high, increase the value of R4 or R5; if the output is low, decrease the value of R4 or R5.

An alternative method of selecting R4 and R5 is to assume that the thermoelement resistance is 90 Ω and select R4 and R5 as 510 Ω in series for the Model 1395A-3 and 110 Ω in series for the Model 1395A-1 and 1100 Ω for Model 1395A-6. If this method is used, the nominal 7.5 mV output may be high or low as much as 10% which is normally of no consequence.

5-3. SETTING INPUT RESISTANCE

The input resistance of the 1395 is used as a precise terminating resistance for the system under test. The 1395 input resistance is factory set at either 50 ohms, 75, 93, 135, 150, or 600 ohms. Late model 50 ohm units use adjustable trim potentiometers to set input resistance while other units select R3.

5-4. ADJUSTING 50 OHM INPUT RESISTANCE WITH POTENTIOMETER R5 (Units With Serial Number Above 4000)

A bridge for adjusting 1395 input resistance is shown in figure 5-2. Schematics for the 1395A-1, 3, and 6 with input resistance trim potentiometers are shown in figures 2-2b, 2-3b, and 2-4b respectively. With the dc power supply drive voltage set for thermoelement operation at 5 μA (full scale), trim potentiometer R5 can be adjusted for nulling of the bridge. Proceed as follows:

a. Set up the bridge using a 50 ohm ±0.05% resistor.

b. Readjust the bridge dc power supply drive voltage so that its output is approximately twice that of the 60 to 80% of the full scale rating of the 1395 UUT. This will safely limit the heater current in the 1395 UUT.

MODEL	BRIDGE VOLTS
1395A-1	1.5 V
1395A-3	4.5 V
1395A-6	9 V

c. Adjust trim resistor R5 to achieve a null indication on the null meter as an indication that the bridge is balanced as an indication of 50 ohm input resistance of the 1395 UUT. The maximum deviation from null should be as follows:

MODEL	50 Ω
1395A-1	±375 μV
1395A-3	±1.2 mV
1395A-6	±2.5 mV

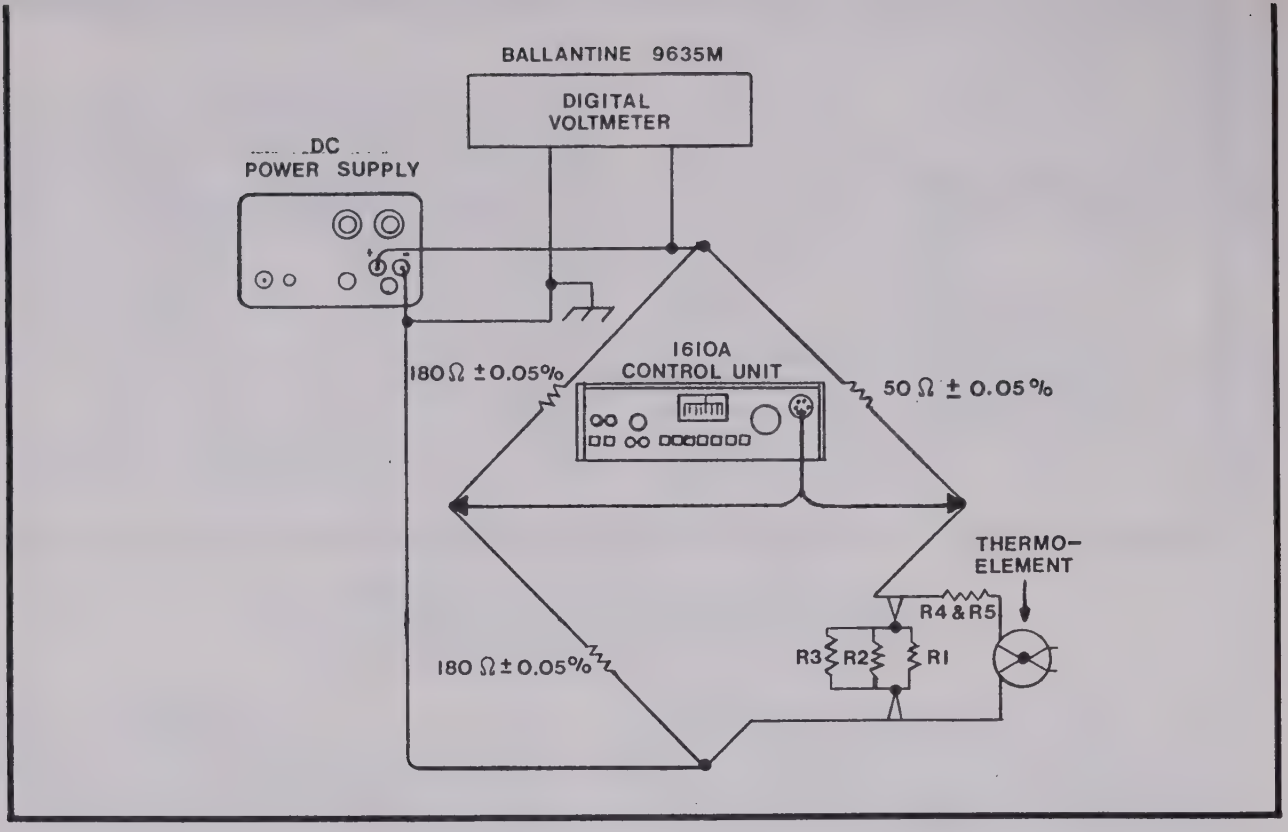


Figure 5-2. Calibration of Input Resistance

5-5. ADJUSTING INPUT RESISTANCE BY SELECTING R3 (For Units With Serial No. Below 4000)

a. R1 and R2 are connected in parallel as illustrated in the schematic diagram, figure 2-1 through 2-7.

b. R3 is selected so that when it is in parallel with R1 and R2 and with the series combination of R4, R5 (in Models 1395A-1, 1395A-3, and 1395A-6) and the thermal element, produce an input resistance of 50 Ω ±0.15 Ω.

c. This selection method is used for Models 1395A-1, 1395A-3, and 1395A-6 where R4 and R5 are used.

d. Resistors R1, R2, R4, and R5 are 1/2 W, ±1%, (40°C), precision film resistors. Selected resistor(s), R3 may be a 1/4 watt, ±1%, precision film resistor or a 1/2 watt carbon composition ±5% resistor.

A bridge for selecting R3 is shown in figure 5-2. With the dc power supply drive voltage set so that the thermoelement operates at approximately its rated full scale input of 5 mA, R3 can be adjusted for null. Proceed as follows:

a. Set the power supply to off, and construct the bridge as shown in figure 5-2.

b. Connect an initial value of R3 as shown in figure 5-2. For Model 1395A-6 and 1395A-3 use two 113 Ω resistors in parallel and a selected value approximately 1.82 kΩ; 1395A-1 use a 140 Ω and a 133 Ω resistor in parallel and a selected value of approximately 47 kΩ; for 1395A-0.4 use a 122 Ω and a 249 Ω resistor plus a selected resistor value of approximately 2.7 kΩ.

c. Adjust the bridge power supply drive voltage to the appropriate value listed below (which will run the respective thermoelement at 60 to 80% of rated current).

MODEL	BRIDGE VOLTS
1395A-0.4	0.6 V
1395A-1	1.5 V
1395A-3	4.5 V
1395A-6	9.0 V

d. Vary resistor R3 to achieve a null indication on the null meter. The maximum deviation from null should be as follows:

MODEL	50 Ω
1395A-0.4	±150 µV
1395A-1	±375 mV
1395A-3	±1.2 mV
1395A-6	±2.5 mV

5-6. OPTIONAL PROCEDURE FOR AC CALIBRATION OF INPUT IMPEDANCE OF THERMAL CONVERTER AT 10 kHz

a. Connect equipment as illustrated in figure 5-3.

CAUTION

Do not connect thermal converter to be calibrated until after step d is completed.

b. Set up impedance bridge (General Radio 1608A) resistive impedance.

c. Adjust test oscillator for output frequency of 10 kHz.

d. Set rms output amplitude of test oscillator for appropriate input for thermal converter to be tested (i.e. 1395A-0.4 - 0.45 V; 1395A-1 - 1.0 V; 1395A-3 - 3.0 V; 1395A-6 - 3 V or 6 V if high power low distortion oscillator is used) as indicated on ac voltmeter, Ballantine Model 323, with a 50 Ω feed thru termination in series with voltmeter input.

e. Disconnect ac voltmeter and connect thermal converter to be tested to UNKNOWN terminals on impedance bridge.

f. Tune impedance bridge for null indicated on NULL meter of bridge. Impedance readout should be 50 Ω ±0.15 Ω. If this readout is not obtained, perform the calibration procedures given in paragraph 4-2, and carefully redress the component in the thermal converter as shown in figure 5-3 then repeat this procedure.

5-7. FREQUENCY FLATNESS COMPENSATION C1

Most 1395 units and all 1395 Option 09 units require capacitive compensation of the thermal element to provide best compensation at 10 MHz (and 100 MHz for Option 09). See Figure 2-2b through 2-4b for schematics showing this compensation. In some units the capacitor is placed across the series resistors and in others it is

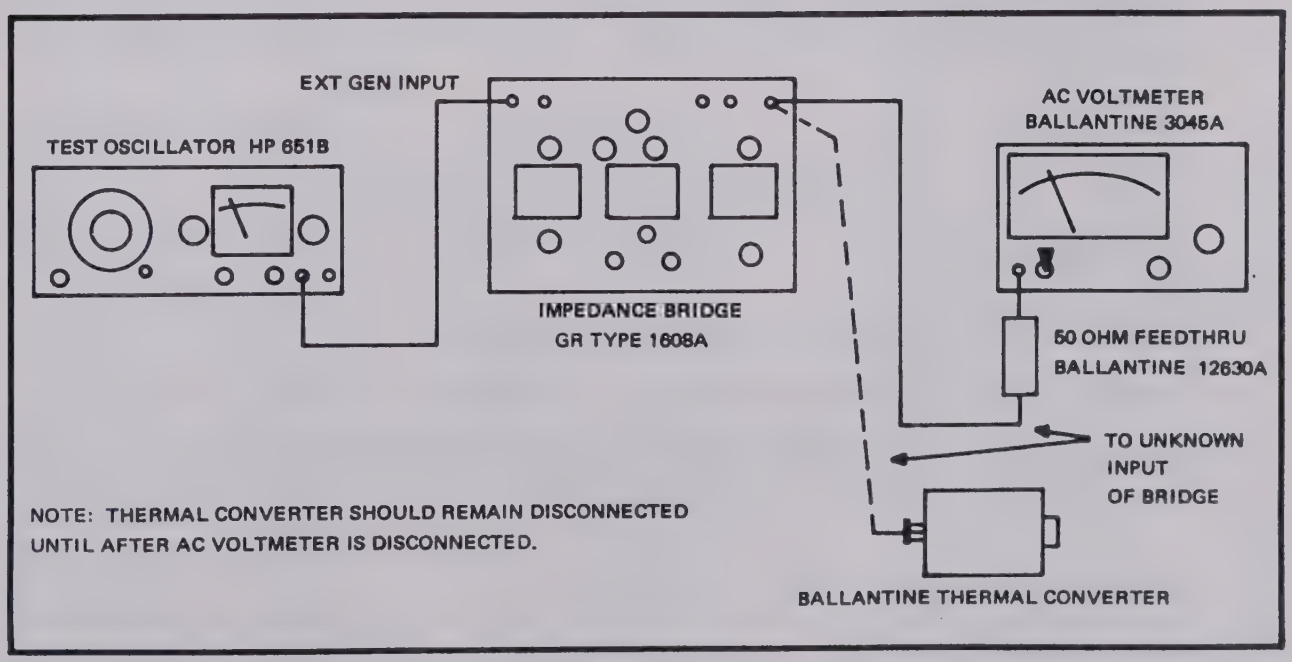


Figure 5-3. AC Calibration of Input Impedance

connected across the thermal element. To assure best high to midband flatness, a resistor may be selected in series with the adjustment capacitor to peak up midband response.

Connect the test set up of figure 4-1. Connect the 1395 UUT and 1395 reference of the same voltage rating directly to a BNC tee as shown in figure 4-1.

a. Apply 1 kHz at 1395 full scale rms amplitude.

b. Null the two 1605 control unit Lindeck potentiometers.

c. Increase the input frequency to 10 MHz (or 100 MHz with Option 09).

d. Adjust the oscillator amplitude to maintain the null output of step a.

e. Adjust C1, the capacitive trimmer, or select C1 until the 1395 UUT null meter nulls ±100 µV as in step a.

f. After adjustment, close the 1395 UUT cover and check at 50 Hz, 500 Hz, 5 kHz, 50 kHz, 500 kHz, 1 MHz, 6 MHz, 10 MHz, (and 30 MHz, 50 MHz, and 100 MHz for Option 09) using the procedure of paragraph 4-2. Record all ac-dc differences of the UUT and correct by adding the ac-dc correction of the reference 1395 at each frequency. Be certain to observe polarity of the ac-dc correction factors. Compute the above and record as the ac-dc correction factors (frequency) flatness of the 1395 UUT.

5-8. INSTALLATION OF THERMOELEMENT AND RESISTORS

The spatial orientation of the components within the thermal converter is critical. Placing the components improperly may cause serious degradation of the higher frequency response.

Field replacement of the thermocouple used in the Model 1395A is possible provided that the leads are cut and shaped to conform exactly to the unit just removed.

CAUTION

Utilize an adequate heat sink when making soldering connections to the thermoelement. Excessive or extended heating will change thermoelement characteristics. Use a grounded soldering iron with a three wire power cord to avoid exceeding the couple to heater breakdown voltage rating.

a. Keep all leads as short as possible.

b. Ensure proper component mounting.

c. Avoid bending thermoelement leads any more than is absolutely necessary as excessive bending may weaken glass seal and reduce isolation.

d. Red (positive) lead should be connected to thermoelement output lead marked with a red dot.

OPTIONAL ACCESSORIES FOR THE 1395A

MODEL	PART NUMBER	DESCRIPTION
All Models	12257A	Low noise connector and cable assembly.
All Models	13941A	Accessory connector kit. Includes cable and various coaxial adapters.
All Models	10130A	3-pin mating "MS3106-A-10SL-3S" output cable connector with clamp and bushing.

PART 6. REPLACEMENT PARTS FOR 1395A WITH SERIAL NUMBER BELOW 4000

MODEL	PART NUMBER	REF DES	DESCRIPTION	MFR CODE	MFR. PART NO.
1395A-0.4	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-0.4	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-0.4	12-13111-0	R...1	RFF 10.0 500.0MW F	016299	CGW NA60
1395A-0.4	12-13194-0	R...2	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-0.4	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1	12-13190-0	R...2	RFF 66.5 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M0D75	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M0D75	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M0D75	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M0D75	12-13195-0	R...2	RFF 121.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M0D75	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M75X	07-02442-0	C...1	CVC 2.0-8PF 200 V	072982	ERIE 538-002A 2-8
1395A-1M75X	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M75X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M75X	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M75X	12-13195-0	R...2	RFF 121.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M75X	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M0D93	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M0D93	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M0D93	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M0D93	12-13196-0	R...2	RFF 178.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M0D93	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M93X	07-02565-0	C...1	CCT 2.2PF J+- 5%	095121	QUAL COMP TP QC
1395A-1M93X	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M93X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M93X	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M93X	12-13196-0	R...2	RFF 178.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M93X	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M135	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M135	31-10228-0	P...1	CON BNC FEM	091836	KC 79-291M06
1395A-1M135	31-10228-0	P...3	CON BNC FEM	091836	KC 79-291M06
1395A-1M135	12-12971-0	R...1	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M135	12-12971-0	R...2	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M135	12-13188-0	R...3	RFF 294.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M135	12-12400-0	R...4	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M135X	07-02544-0	C...1	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-1M135X	07-02544-0	C...2	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-1M135X	07-02544-0	C...3	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-1M135X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M135X	31-10228-0	P...1	CON BNC FEM	091836	KC 79-291M06

MODEL	PART NUMBER	REF DES	DESCRIPTION	MFR CODE	MFR. PART NO.
1395A-1M135X	31-10228-0	P...3	CON BNC FEM	091836	KC 79-291M06
1395A-1M135X	12-12971-0	R...1	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M135X	12-12971-0	R...2	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M135X	12-13188-0	R...3	RFF 294.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M135X	12-12400-0	R...4	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-1M150	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M150	31-10228-0	P...1	CON BNC FEM	091836	KC 79-291M06
1395A-1M150	31-10228-0	P...3	CON BNC FEM	091836	KC 79-291M06
1395A-1M150	12-12971-0	R...1	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M150	12-12971-0	R...2	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M150	12-13197-0	R...3	RFF 383.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M150X	07-02544-0	C...1	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-1M150X	07-02544-0	C...2	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-1M150X	07-02544-0	C...3	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-1M150X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M150X	31-10228-0	P...1	CON BNC FEM	091836	KC 79-291M06
1395A-1M150X	31-10228-0	P...3	CON BNC FEM	091836	KC 79-291M06
1395A-1M150X	12-12971-0	R...1	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M150X	12-12971-0	R...2	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1M150X	12-13197-0	R...3	RFF 383.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-3	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-3	12-13191-0	R...1	RFF 511.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3	12-13192-0	R...2	RFF 54.9 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-3-09	07-02514-0	C...1	CCT 7.5PF 500 V J+- 5%	095121	QUAL COMP TYP QC
1395A-3-09	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-3-09	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-3-09	12-13191-0	R...1	RFF 511.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3-09	12-13192-0	R...2	RFF 54.9 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3-09	12-12400-0	R...3	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-3M600	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-3M600	31-10228-0	P...1	CON BNC FEM	091836	KC 79-291M06
1395A-3M600	31-10228-0	P...3	CON BNC FEM	091836	KC 79-291M06
1395A-3M600	12-13187-0	R...1	RFF 255.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3M600	12-13187-0	R...2	RFF 255.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3M600X	07-02544-0	C...1	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-3M600X	07-02544-0	C...2	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-3M600X	07-02544-0	C...3	CCT 1.5PF 500 V J+- 5%	095121	QUAL COMP TP QC
1395A-3M600X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-3M600X	31-10228-0	P...1	CON BNC FEM	091836	KC 79-291M06
1395A-3M600X	31-10228-0	P...3	CON BNC FEM	091836	KC 79-291M06
1395A-3M600X	12-13187-0	R...1	RFF 255.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3M600X	12-13187-0	R...2	RFF 255.0 500.0MW F	080031	MEPCO RN60D 0/E

PART 6. REPLACEMENT PARTS FOR 1395A WITH SERIAL NUMBER BELOW 4000 - Continued

MODEL	PART NUMBER	REF DES	DESCRIPTION	MFR CODE	MFR. PART NO.
1395A-6	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-6	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-6	12-13193-1	R...1	RFF 1.10K 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6	12-13194-0	R...2	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6	12-13194-0	R...3	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6	12-12400-0	R...4	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
1395A-6-09	07-02507-0	C...1	CCT 8.2PF 500 V K 10%	078488	STACKPOLE TYPE GA
1395A-6-09	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-6-09	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-6-09	12-13193-1	R...1	RFF 1.10K 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6-09	12-13194-0	R...2	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6-09	12-13194-0	R...3	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6-09	12-12400-0	R...4	RFF 10.0 K 250.0MW F+- 1%	016299	CGW RN55D 1002 F
All Models	46-10000-0	L...1	FRB FERRITE BEAD	078488	STACKPOLE 57-0180-7D
All Models	46-10000-0	L...2	FRB FERRITE BEAD	078488	STACKPOLE 57-0180-7D
"A" Series	27-07946-1	TC..1	THC 5MA 0.04% REV.	050423	BLI
"H" Series	27-10000-1	TC..1	THC 5MA .005% UHF	050423	BLI

PART 6. REPLACEMENT PARTS FOR 1395A WITH SERIAL NUMBER ABOVE 4000

MODEL	PART NUMBER	REF DES	DESCRIPTION	MFR CODE	MFR. PART NO.
1395A-1	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1	12-12244-0	R...2	RFF 287.0 250.0MW F+-1%	016299	CGW RN55D 2870 F
1395A-1	12-12971-0	R...3	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1	09-10001-0	R...5	RVC 500.0 0.5 W K	073138	HEL TYP 72PMR
1395A-1-09	07-02442-0	C...1	CVC 2.0-8PF 200 V	072982	ERIE 538-002A 2-8
1395A-1-09	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1-09	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1-09	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1-09	12-12244-0	R...2	RFF 287.0 250.0MW F+-1%	016299	CGW RN55D 2870 F
1395A-1-09	12-12971-0	R...3	RFF 80.6 500.0MW F 50PPM	016299	CGW RN60C 50PPM
1395A-1-09	09-10001-0	R...5	RVC 500.0 0.5 W K	073138	HEL TYP 72PMR
1395A-1M0D75	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M0D75	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M0D75	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M0D75	12-12204-0	R...2	RFF 110.0 250.0MW F+-1%	016299	CGW RN55D 1100 F
1395A-1M0D75	09-10229-0	R...5	RVF 20.0 500.0MW CERMET	073138	HELIPOT 72PM-20
1395A-1M75X	07-02442-0	C...1	CVC 2.0-8PF 200 V	072982	ERIE 538-002A 2-8
1395A-1M75X	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M75X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M75X	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E

MODEL	PART NUMBER	REF DES	DESCRIPTION	MFR CODE	MFR. PART NO.
1395A-1M75X	12-12204-0	R...2	RFF 110.0 250.0MW F+-1%	016299	CGW RN55D 1100 F
1395A-1M75X	09-10229-0	R...5	RVF 20.0 500.0MW CERMET	073138	HELIPOT 72PM-20
1395A-1MOD93	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1MOD93	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1MOD93	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1MOD93	12-12221-0	R...2	RFF 165.0 250.0MW F+-1%	016299	CGW RN55D 1650 F
1395A-1MOD93	09-10229-0	R...5	RVF 20.0 500.0MW CERMET	073138	HELIPOT 72PM-20
1395A-1M93X	07-02442-0	C...1	CVC 2.0-8PF 200 V	072982	ERIE 538-002A 2-8
1395A-1M93X	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-1M93X	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-1M93X	12-13189-0	R...1	RFF 110.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-1M93X	12-12221-0	R...2	RFF 165.0 250.0MW F+-1%	016299	CGW RN55D 1650 F
1395A-1M93X	09-10229-0	R...5	RVF 20.0 500.0MW CERMET	073138	HELIPOT 72PM-20
1395A-3	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-3	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-3	12-13191-0	R...1	RFF 511.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3	12-12244-0	R...2	RFF 287.0 250.0MW F+-1%	016299	CGW RN55D 2870 F
1395A-3	12-13190-0	R...3	RFF 66.5 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3	09-10095-0	R...5	RVF 50.0 500.0MW M	073138	HELIPOT 72PM 50
1395A-3-09	07-02442-0	C...1	CVC 2.0-8PF 200 V	072982	ERIE 538-002A 2-8
1395A-3-09	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-3-09	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-3-09	12-13191-0	R...1	RFF 511.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3-09	12-12244-0	R...2	RFF 287.0 250.0MW F+-1%	016299	CGW RN55D 2870 F
1395A-3-09	12-13190-0	R...3	RFF 66.5 500.0MW F	080031	MEPCO RN60D 0/E
1395A-3-09	09-10095-0	R...5	RVF 50.0 500.0MW M	073138	HELIPOT 72PM 50
1395A-6	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-6	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-6	12-13193-0	R...1	RFF 1.10K 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6	12-13194-0	R...2	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6	12-13194-0	R...3	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6	12-12330-0	R...4	RFF 2.05K 250.0MW F+-1%	016299	CGW RN55D 2051 F
1395A-6	09-10004-0	R...5	RVF 100.0 0.5 W M	073138	HEL TYP 72PM
1395A-6-09	07-02442-0	C...1	CVC 2.0-8PF 200 V	072982	ERIE 538-002A 2-8
1395A-6-09	31-10227-0	J...1	CON BNC MALE FLNGE	091836	KINGS UG1104 A/U
1395A-6-09	31-10001-0	J...2	CON 3 PIN MALE REC	029587	AMPH MS-3102A-10SL-3P
1395A-6-09	12-13193-0	R...1	RFF 1.10K 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6-09	12-13194-0	R...2	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6-09	12-13194-0	R...3	RFF 107.0 500.0MW F	080031	MEPCO RN60D 0/E
1395A-6-09	12-12330-0	R...4	RFF 2.05K 250.0MW F+-1%	016299	CGW RN55D 2051 F
1395A-6-09	09-10004-0	R...5	RVF 100.0 0.5 W M	073138	HEL TYP 72PM
All Models	46-10000-0	L...1	FERRITE BEADS, 57-0180-70	078488	STACKPOLE 57-0180-7D
All Models	46-10000-0	L...2	FERRITE BEADS, 57-0180-70	078488	STACKPOLE 57-0180-7D
"A" Series	27-07946-1	TC..1	THC 5MA 0.04% REV.	050423	BLI
"H" Series	27-10000-1	TC..1	THC 5MA .005% UHF	050423	BLI

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ADDENDUM

TO INSTRUCTION MANUAL:

MODEL No. 1395A-MOD103

Adds 1395A-MOD103 Series of
Thermal Voltage Converters
#2 (90-10013-5E)

The 1395A-MOD103 kit consists of the following items:

1 each	Model 1395A-0.4-09 Thermal Voltage Converter
1 each	Model 1395A-1-09 Thermal Voltage Converter
1 each	Model 1395A-3-09 Thermal Voltage Converter
1 each	Model 1395A-6-09 Thermal Voltage Converter
1 each	Model 12257A Low Noise Connector
1 each	89-11172-1A Kit Case
1 each	90-10013-5E Instruction Manual

Schematic Diagrams and Replacement Parts Lists are included in Section 3 (1395A Series Terminated Thermal Voltage Converters) of the Instruction Manual.

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ADDENDUM

TO INSTRUCTION MANUAL: **MODEL No.** 1395A

#1 (90-10344-5A)

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5-1 REPAIRING THE THERMAL CONVERTER

Change: and series resistors R4 and R5 in the circuit (see

To: and series resistor R1 in the circuit (see

5-2 OPTIONAL SELECTION OF SERIES CURRENT LIMITING RESISTORS R4 and R5

Retitle: 5-2 OPTIONAL SELECTION OF SERIES CURRENT LIMITING RESISTOR R1

Delete: All of this section except the last paragraph

Change: and select R4 and R5 as 510 Ω in series for the Model 1395A-3 and 110 Ω in series for the Model

To: and select R1 as 510 Ω for the Model 1395A-3 and 110 Ω for the Model

Change: method is used, the nominal 7.5 mv output may be high or low as much as 10% which is normally of no

To: method is used, the nominal 7 mv output may be high or low as much as 15% which is normally of n

Page 36.

5-5 ADJUSTING INPUT RESISTANCE

Change: a. R1 and R2

To: a. R2 and R3

Delete: b. ... and R2 ...

Change: b. ... R4 ...

To: b. ... R2 ...

Delete:	c. ... where R4 and R5 are used.
Delete:	d. ... R2, R4 ...
Change:	d. ... R5 ...
To:	d. ... R2 ...

MP MASTER
MA31017

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